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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/941,612	08/30/2001	Yoshinobu Aoyagi	1794-0141P	6758

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BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1714	

NOTIFICATION DATE	DELIVERY MODE
06/24/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mailroom@bskb.com

Office Action Summary	Application No.	Applicant(s)	
	09/941,612	AOYAGI ET AL.	
	Examiner	Art Unit	
	MATTHEW J. SONG	1714	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 March 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *37,40,42 and 44* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *37,40,42 and 44* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/15/2010*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 37, 40, 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al (US 5,693,139) in view of Edmond et al (US 5,739,554).

Nishizawa et al discloses a method of growing doped semiconductor monolayers, note entire reference, comprising raw material gases of Gallium (Ga) and Arsenic (As), where Ga is supplied for 0.5 to 10 seconds, the chamber is evacuated, this clearly suggests applicant's purged for a predetermined time, and As is supplied for 2 to 200 seconds and the cycle is repeated (col 7, ln 1-67; col 8, ln 1-30 and Fig 7B and Fig 11). Nishizawa et al also discloses a p-type layer is formed by introducing an impurity gases and Ga simultaneously but alternately with an As

source, where the impurity gas is an Mg, Zn or Cd containing gas or Silane. Nishizawa et al also discloses a n-type layer doped with Se or S and the impurity gas is introduced cyclically with the Ga gas and As gas or the impurity gas and Ga gas are introduced simultaneously but alternately with the As gas (col 8, In 31-60). Nishizawa et al also discloses forming pnp bipolar transistors (col 8, ln 61-67). Nishizawa et al also discloses nozzles 44, 45 and 46 for introducing gaseous compounds used for impurity doping for introducing group II, IV and VI gases (col 10, ln 50-67). Nishizawa et al also discloses different modes of doping, where the dopant is added at the exhaustion of an As gas, the introduction of a Ga gas, the exhaustion of a Ga gas or at the introduction of As gas (col 11-13 and Fig 11). Nishizawa et al also discloses other III-V semiconductors are applicable to the invention (col 14, ln 5-55). Nishizawa et al also discloses introduction of a Ga source gas and a group II dopant simultaneously to form a p-type layer (col 8, ln 30-45) and the introduction of a group IV dopant atter the introduction ofa Ga source gas (col 15, ln 5-50). Nishizawa et al also discloses selection of the timing of doping with respect of the source gas introduction is based on the desired dopant type for the monolayer being grown (col 15, ln 45-55). Nishizawa et al teaches supplying reactants for a short period of time (col 11, ln 50-60), this clearly suggests applicants pulsed manner. Nishizawa et al also teaches supplying impurities cyclically at the time of or during the cyclical introduction of the first gas source to grow either a p-type or n-type crystal layer (col 8, ln 32-57) and two impurities can also be introduced simultaneously at the time the first gas source is introduced (col 8, ln 47-50).

Nishizawa et al does not disclose the given time for supplying each of the impurity raw

materials for doping an impurity pair of at least one p-type and at least one n-type raw material into only the first layer, wherein one p-type or n-type dopant and then supplying the other one of the at least one p-type or n-type dopant.

Edmond et al teaches a gallium nitride (GaN) layer co-doped with both a Group II acceptor and Group IV donor (col 4, ln 50-67), where the group II acceptors include Zn or Mg and the Group IV donors include Si or Ge (col 6, ln 20-50). Edmond et al also discloses the GaN layer is formed by CVD, where Trimethylgallium (TMG), ammonia, silane and biscyclopentadienyl magnesium, $(Cp)_2Mg$ are used as reactant gases (col 7, ln 45-67 and col 8, ln 1-50).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishizawa et al to supply both the acceptor and the donor impurities taught by Edmond in the manner taught by Nishizawa in Nishizawa's process, motivated by a reasonable expectation of successfully growing a layer having pn junctions useful for bipolar transistor structures because Nishizawa recognizes that the timing or sequence of the impurity introduction is a result effective variable (col 15, ln 43-50) and determining the sequence of dopant introduction to obtain the claimed sequence by conducting routine experimentation of a result effective variable.

Referring to claim 40, the combination ofNishizawa et al and Edmond et al teaches forming a co-doped GaN layer using Mg and Si dopant, where the compound semiconductor layer is grown in monolayer by alternate introduction of source gases and the chamber being evacuated continuously throughout the whole method (' 139 col 3, In 35-45) and the Si is introduced after the Ga source gas to act as a donor, and a Ga source and a Mg dopant are

introduced simultaneously but alternately with a As source.

Referring to claim 42, the combination of Nishizawa et al and Edmond et al teaches Ga as a first raw material gas and As or N as a second raw material gas.

3. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al (US 5,693,139) in view of Edmond et al (US 5,739,554) as applied to claims 37, 40, and 42 above, and further in view of Manabe et al (US 6,472,690).

The combination of Nishizawa et al and Edmond et al teaches all of the limitations of claim 44, as discussed previously, including using silane as a Si dopant. The combination of Nishizawa et al and Edmond et al does not teach supplying TESi

In a method of forming a gallium nitride compound semiconductor, note entire reference, Manabe et al teaches forming an n+ type Gallium nitride layer, using silane or tetraethylsilane (TESi) (Example 4). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Nishizawa et al and Edmond et al with Manabe et al because substituting known equivalents for the same purpose is obvious (MPEP 2144.06).

Response to Arguments

4. Applicant's arguments with respect to claims 37, 40, 42 and 44 have been considered but are moot in view of the new ground(s) of rejection.

5. Applicant's arguments filed 3/29/2010 have been fully considered but they are not persuasive.

The arguments are directed to the declaration which is not persuasive for the reasons discussed below; therefore the arguments are not persuasive.

The declaration under 37 CFR 1.132 filed 3/29/2010 is insufficient to overcome the rejection of claims 37, 40, 42 and 44 based upon the 35 U.S.C. 103(a) rejection over Nishizawa et al (US 5,693,139) and Edmond et al (US 5,739,554) as set forth in the last Office action because: the showing is not commensurate with the scope of the claims. The declaration is limited in scope to a method of doping Ga with Mg and Si. However, instant claim 37 broadly claims a first crystal raw material, a second crystal raw material, an n-type dopant and a p-type dopant. Therefore, the limited scope of the evidence in the declaration is insufficient to show unexpected results for the scope of the instantly claimed invention. Also, the declaration states that the Ga film doped with Mg and then doped with Si is the only method by which molecular co-doping can be effected (pg 4 of the declaration). However, as claimed in claim 37 the introduction of n-type or p-type impurities is broadly claimed such that n-type doping can be followed by p-type doping. Second, the declaration admits that even with concurrent supply of impurities Mg-Si pairs are produced (see page 3 of the declaration), impurity pair barely produced but are still produce even with the concurrent supply of impurities, thus meets the claimed limitation. Third, the declaration merely make statements regarding activation energy decrease, carrier increases which result in improvements to conductivity without any persuasive experimental evidence. It is noted that the declaration contradicts applicant's disclosure. Paragraph [0107] of applicant's published application teaches impurity doping according to the present invention comprises plural types of impurity raw materials being supplied at close timings in a pulsed manner either at the same time of or after starting a supply of either types of

crystal raw materials, whereby a carrier concentration is increased in even the case where p-type impurity raw materials and n-type raw materials are used so that is becomes possible to prepare a semiconductor having a high conductance. Also, paragraph [0059] of applicant's published application teaches p-type and n-type impurities supplied at the same time of starting a supply of crystal raw material A. Finally, the declaration also discussed features which are not claimed. The declaration notes distinctions between Si and Mg arrayed side-by-side to produce Mg-Si pairs, and Si and Mg are discretely put in position without maintaining side-by-side array relations such that Mg-Si pairs are barely produced. The arrangement of the Si and Mg is not claimed, thus the argument is not persuasive.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. SONG whose telephone number is (571)272-1468. The examiner can normally be reached on M-F 11:00-7:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on 571-272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1714

MJS
June 19, 2010

/Robert M Kunemund/
Primary Examiner, Art Unit 1714